

# Android 101

Jim Kolotouros

Prepared by Android Global Business team [REDACTED], Christopher Li, Sidney Lee)  
May 2019

Google

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**EXHIBIT 647.R**

EXHIBIT 647.R-001

# Agenda

What is Android?

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Why did we build it?

---

Where are we now?

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Challenges and opportunities on the horizon

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# The Basics

What is Android? Overview of  
Android, Google Mobile Services  
(GMS), Compatibility, and  
Fragmentation

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## Google Search and Services in early 2000s....

A SINGLE SERVICE ON A SINGLE WEBPAGE ON A SINGLE BROWSER ON A SINGLE OS



### Evolution of a desktop strategy:

- We had access via Windows (IE) and then Mac (OS X/Safari) but always worried about getting blocked by 3rd party OS/browser platforms
- Netscape Navigator = Google's first search distribution deal. Firefox and Safari search deals came later
- Google Toolbar & Protector provided access to IE users
- Initiated Chrome browser so that i) service & feature innovation, and ii) user access to search/services would not be throttled by IE
- ChromeOS eventually evolved from Chrome browser

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## A very new landscape in 2007

**Market Landscape:** iPhone launches in June 2007 which accelerates adoption of smart devices on multiple platforms



Nokia



Samsung



Apple



Motorola



LG



Sony

Google

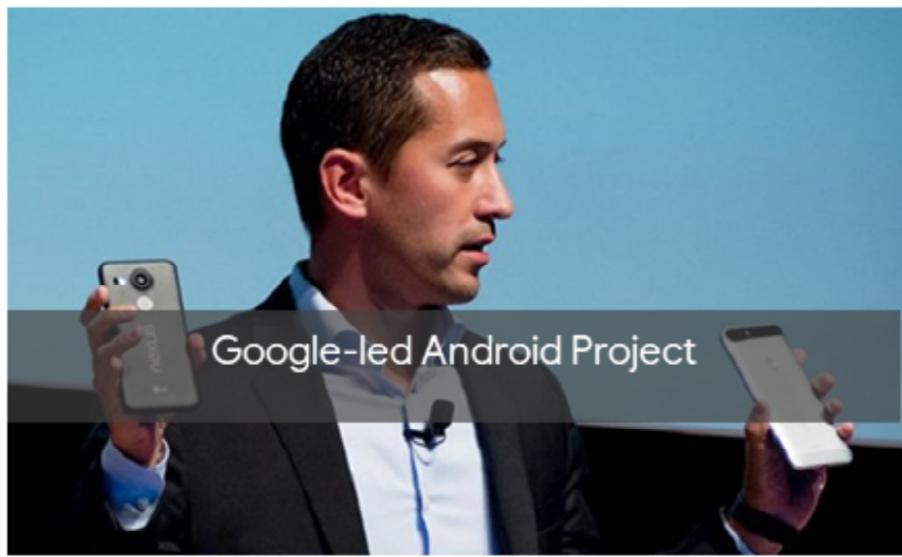
### IMPLICATIONS

- Same platform concerns as desktop; access and innovation
- Impossible to scalably get great experiences/apps in front of users - app team had to optimize each app for every single device / platform permutation ("fragmentation")
- **What can Google do to focus its solutions/services innovations?**
- **What would make sense for Google as an App developer?**

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Android Open Source Project (AOSP) provided the solution to evolving market conditions for many...



Operator	Handset Makers	Software Companies	Commercialization Companies	Semiconductor Companies
SoftBank DoCoMo au China Mobile	HTC Desiging The Future KDDI Sprint LG Electronics MOTOROLA SAMSUNG GARMIN	Ascender® Corporation Google Living Image vodafone Telenor Telefónica TELECOM Italia China Unicom	eBay myriad™ hexagon NUANCE SONVOX SIP omron SVOX	Apliz® Corporation BORQS noser TELECA WIND RIVER
	acer			AKM Texas Instruments ERICSSON ATHEROS ARM
	TOSHIBA			

Supported by consortium of partners

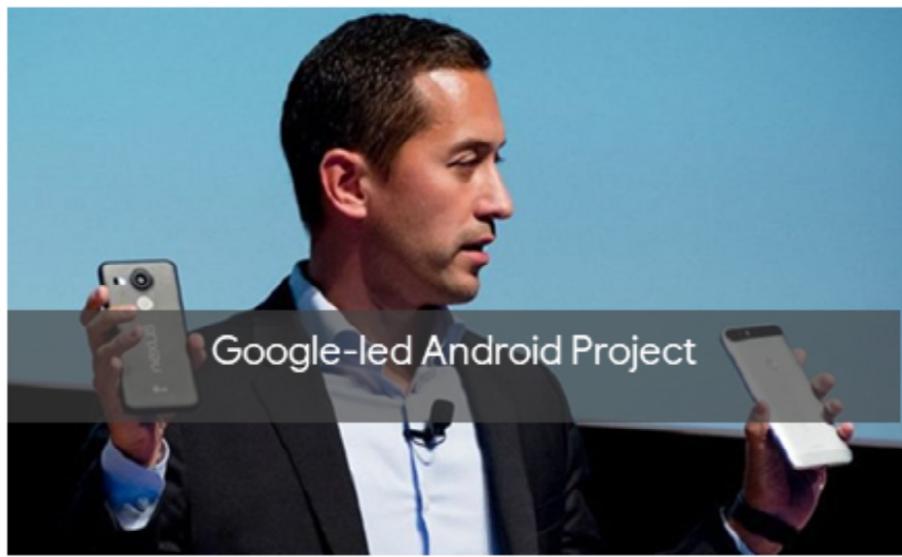
- Created a solution to address platform and developer fragmentation: Bought by Google in 2005
- Ally with key ecosystem partners: Created an alliance with a consortium of partners in 2007 to make an open source platform for ecosystem partners to participate and compete in the rapidly growing smartphone industry
- **Create friendly policies to encourage adoption by OEM's, developers, SOC's, etc.:**

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Android Open Source Project (AOSP) provided the solution to evolving market conditions for many...



Operator	Handset Makers	Software Companies	Commercialization Companies	Semiconductor Companies
SoftBank	HTC Desiring The Future <b>KDDI</b>	Ascender® Corporation LG Electronics MOTOROLA SAMSUNG GARMIN	eBay myriad® Living Image hexagon	Apliz® Corporation BORQS noser
DoCoMo	Sprint	NUANCE vodafone HUAWEI T-Mobile Telefonica TELECOM Italia China Unicom	dv SONVOX Sipit	Audience BROADCOM intel NVIDIA QUALCOMM SiRF Synaptics Texas Instruments ERICSSON AKM ARM
au		acer ASUS TOSHIBA	omron EVOKIII WIND RIVER	ATHEROS

Supported by consortium of partners

- Created a solution to address platform and developer fragmentation: Bought by Google in 2005 to make an open source platform for ecosystem partners to participate and compete in the rapidly growing smartphone industry
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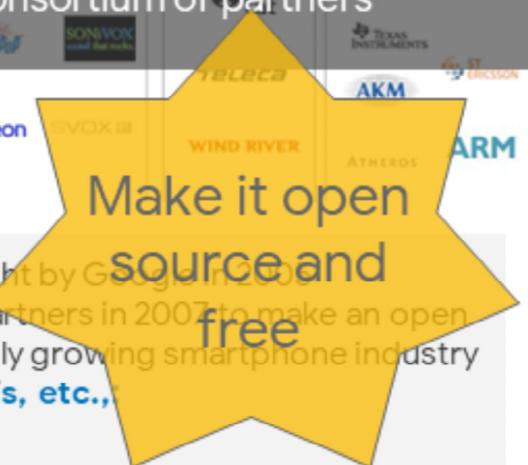


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## What is AOSP?



- The Android Open Source Project (AOSP) consists of 3 key elements:
  - (1) An operating system,
  - (2) middleware, and
  - (3) open-source apps (e.g., dialer, email, gallery, and messaging services).
- Manufacturers, carriers, and third-party developers can use these components as-is or can customize them into their own proprietary versions without a license from Google.
- Amazon is one example of a company which uses AOSP to built out their own proprietary version (FireOS)

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## What is compatibility? Why & where does it matter?

Device compatibility is important to ensure that developers have confidence that their app will work perfectly on a specific form factor; it allows developers to focus their creativity and innovation while accessing a maximum universe of devices & users

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## Compatibility stretches across different form factors as well

The Android platform works across several device form factors - **mobile devices (smart phones, tablets), wearables, TVs, and auto**; therefore, the Android compatibility requirements apply to these device types as well



**Note:** Wear, Auto, Audio, and TV are unique in that GMS-equivalents for wearables and TV's requires more than just a MADA (more on this later)

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## Google Mobile Services (GMS) layered on top of AOSP



- The Android Open Source Project (AOSP) consists of 3 key elements:
  - (1) An operating system,
  - (2) middleware, and
  - (3) open-source apps (e.g., dialer, email, and messaging services).
- Manufacturers, carriers, and third-party developers can use these components as-is or can customize them into their own proprietary versions without a license from Google.
- **Google Mobile Services (GMS) apps, in contrast, are Google's proprietary apps**

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## AOSP and Google Mobile Services (GMS) are often inaccurately intermixed and misunderstood

PURE AOSP



AOSP +  
GMS pre-loaded onto device



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OEMs can choose to load Google Mobile Service (GMS) on any (or none) of their devices to provide a more comprehensive out-of-box experience.

This point is not always well understood.

GOOGLE IN EUROPE

Android has created more choice, not less



Sundar Pichai  
CEO

Published on 16.01.2018

If you buy an Android phone, you're choosing one of the world's two most popular mobile platforms—one that has expanded the choice of phones available around the world. Today, the European Commission issued a competition decision against Android, and its business model. The decision ignores the fact that Android phones compete with iOS phones, something that 89 percent of respondents to the Commission's own market survey confirmed. It also misses just how much choice Android provides to thousands of phone-makers and mobile network operators who build and sell Android devices; to millions of app developers around the world who have built their businesses with Android; and billions of consumers who can now afford and use cutting-edge Android smartphones.

Today, because of Android, there are more than 14,000 devices, at every price point, from more than 1,300 different brands, including Dutch, French, German, Hungarian, Italian, Latvian, Polish, Romanian, Spanish and Swedish phone makers.

Android provides choice

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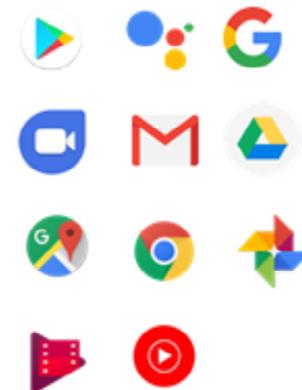
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# We believed Google Applications would enhance the user experience on mobile phones and tablets

## What is GMS?

- **GMS is a collection of Google applications** for Android
  - Most GMS apps are optional and available a la carte
  - Some GMS apps are only available in a bundle; but there is no obligation for OEM's to pre-load these
- GMS works beautifully on *compatible* Android smartphones / tablets and is intended to provide the best possible mobile experience on smartphones (feature phones are in play again too!)
- App updates are administered by Google Play
  - E.g., Google Maps cannot be updated on a device if Play is also not installed
- **There is not a single agreement with any OEM that requires them to pre-load any GMS app on their device**

## GMS MANDATORY APPS



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# Google Play Services / GMS Core is an important element of Play

## What is Google Play Services / GMS Core?

- Play Store provides a set of Google APIs that help support functionality of all Android applications (aka GMS Core APIs, Google Play Services)
  - Ads
  - Maps
  - Analytics
  - Location, etc.,
- Used by GMS, and hundreds of thousands of 3rd party apps
- 826 out of the top 1000 Android apps use 1 or more GMS Core APIs (Facebook, WhatsApp, Twitter, and many other apps)

## GmsCore API Usage (3P)

- Only apps evaluated by Marmot (mostly limited to apps in active in Google Play Store)

### Nr Applications using GmsCore API

	Count
- All	636,142
gms.ads	414,506
gms.common	353,587
gms.maps	164,252
gms.gcm	140,041
gms.analytics	97,374
gms.location	90,457
gms.plus	74,466
gms.games	52,085
gms.auth	39,121
gms.appstate	21,439
gms.internal	16,634
gms.b	8,449
gms.a	6,472
gms.wallet	4,537
gms.drive	4,263
gms.cast	3,953
gms.wearable	3,820

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# GMS requires signing a set of agreements with Google - ACC and MADA are the two main ones

## Android Compatibility Commitment (ACC)



What does Google get

**Compatibility:** Company will **only distribute Android devices that are Android-Compatible Devices**. i.e., if a device uses Android (even without GMS), it must be compatible (pass the compatibility test suite; comply with CDD). Exceptions are granted on a case-by-case basis

but...

Companies do not need to sign any other agreements, such as MADA, although almost all OEMs take this step. Carriers and retailers do not/cannot sign the ACC

## Mobile Application Distribution Agreement (MADA)



**Pre-load + Placement:** Pre-load i) GMS mandatory apps, and ii) search widget, Play store, and Google Collection on the default home screen (i.e., invoked by the home button)

**MADA gives OEMs a device-by-device choice.** OEM can pre-load any other application in addition to Google services; there's no obligation for an OEM to load GMS on any device. **Zero exclusivity within the MADA**

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## Common misconceptions with Android & GMS

STATEMENT	TRUE	FALSE	REALITY
If a partner signs up for a GMS license, all their devices must include GMS	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Partner can choose whether or not to pre-load GMS onto their devices on a <b>device-by-device</b> basis
An Android device that does not have GMS pre-installed is a fork of Android	<input type="checkbox"/>	<input checked="" type="checkbox"/>	A device is defined as a fork of Android if the underlying ROM (software image) is not Android-compatible
Google requires some app exclusivity as part of the GMS licensing process	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There are no exclusivity provisions as part of the MADA agreement. However, we do offer to select partners a revenue share opportunity in exchange for some exclusivity clauses. The revenue share agreement is <b>separate from</b> GMS licensing.

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## So what is actually a forked device?

“ABI Research reports that forked Android or AOSP smartphones grew 20% sequentially from 1Q 2014 to 2Q 2014 (total market growth was 3% sequentially) and also accounted for **20% of the smartphone market.**”

-ABI Research



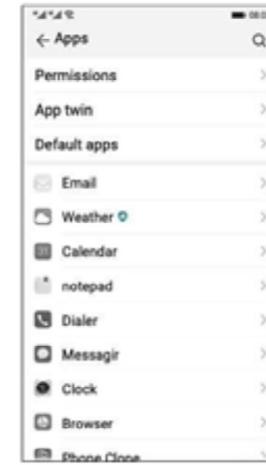
Xiaomi  
MIUI



OnePlus  
Oxygen OS



Amazon  
Fire OS



Huawei  
HongMeng OS

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-ABI Research



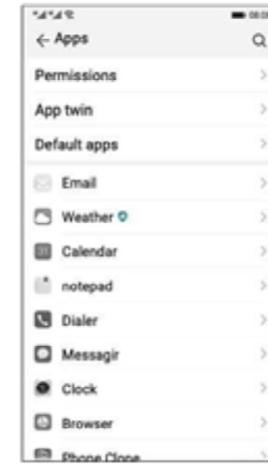
Xiaomi  
MIUI



OnePlus  
Oxygen OS



Amazon  
Fire OS



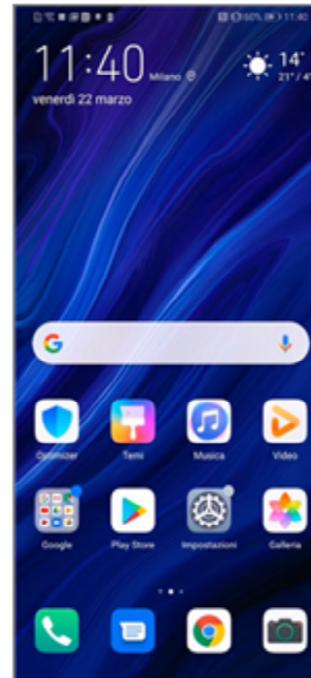
Huawei  
HongMeng OS

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## Huawei Case Study - what will they be able to do / not do?



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# Benefits of Android

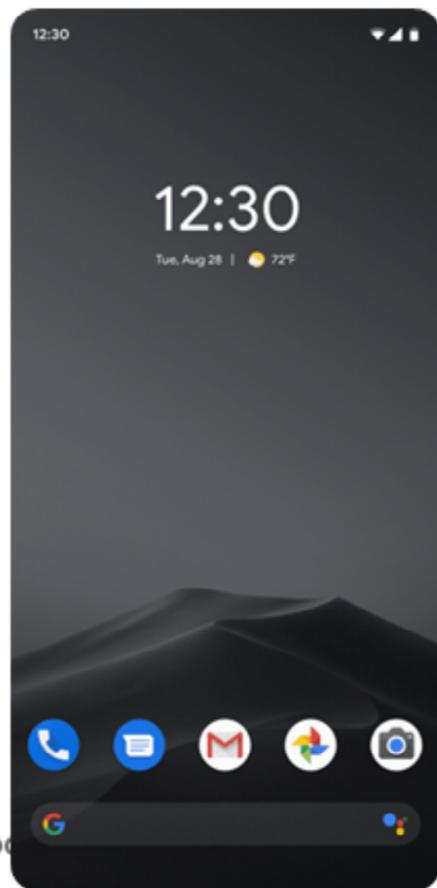
- Why did we build the platform?
- What's the macro relationship to Google?

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Android was built to help secure more users for Google services...



### Tools and programs to make Google internet services successful

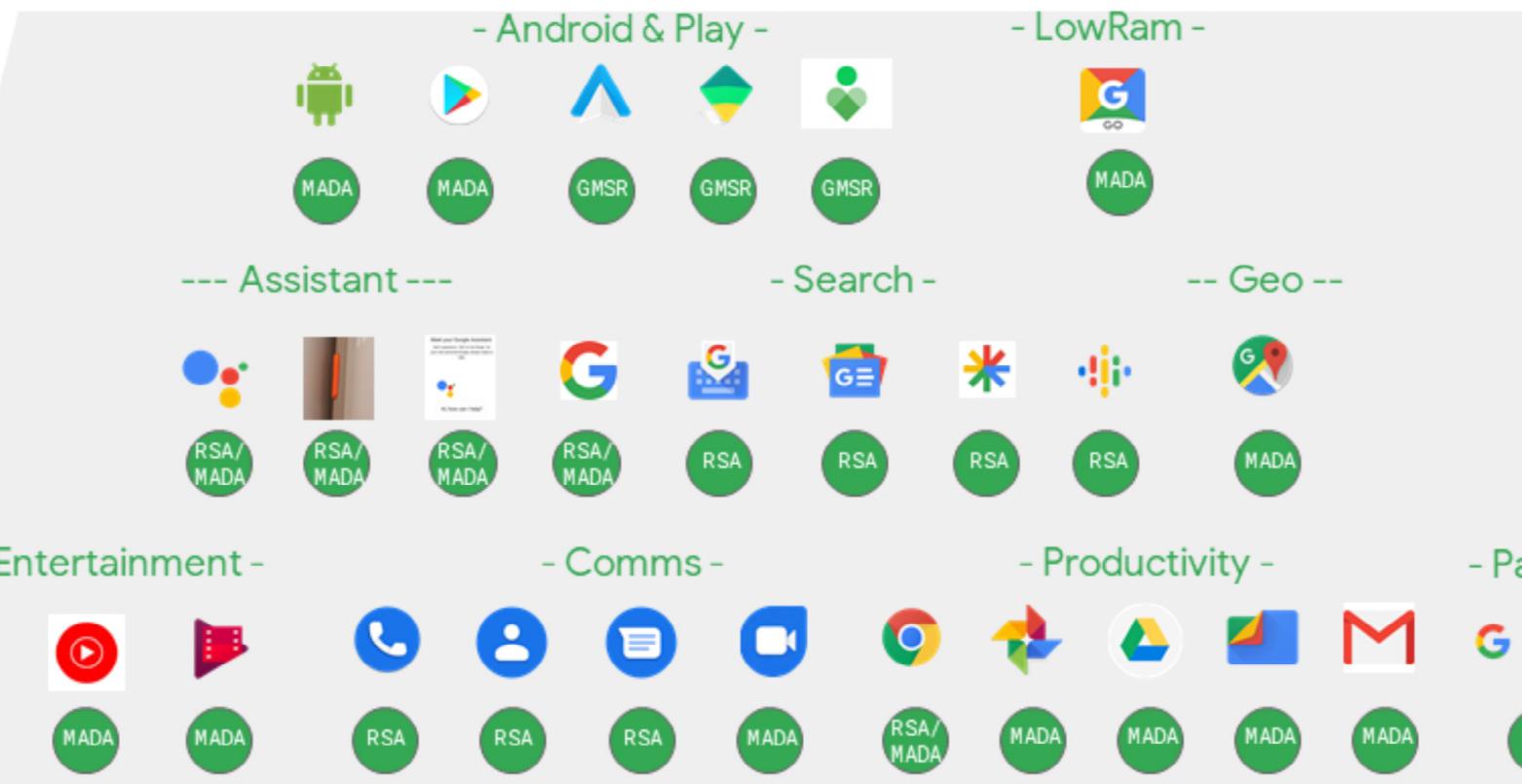
Preload	Default Intent	Placement (Hotseat, DHS)	First three + exclusivity
MADA	RSA	RSA	RSA
GMS Req	Program	Program	Program
RSA	Bespoke	Bespoke	Bespoke
Programs: GMS Express, A-Go			
Bespoke: Ex: "N50M", "Waterloo", "Optimus"			

As baseline, apply MADA / GMS to 1B new device activations per year, and RSA / Programs / Bespoke to large subset of new activations

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Android was built to help secure more users for Google services...



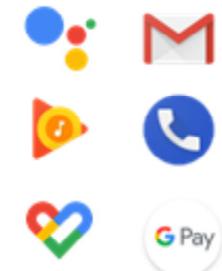
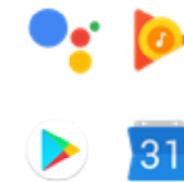
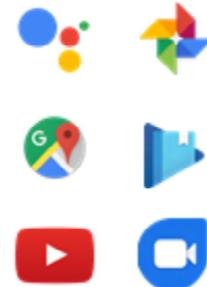
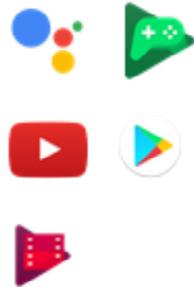
Android also owns the APIs, definitions, and requirements for which the ecosystem (apps, devices) must abide by

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EXHIBIT 647.R-022

... across all device verticals



Note: only a sampling; not comprehensive

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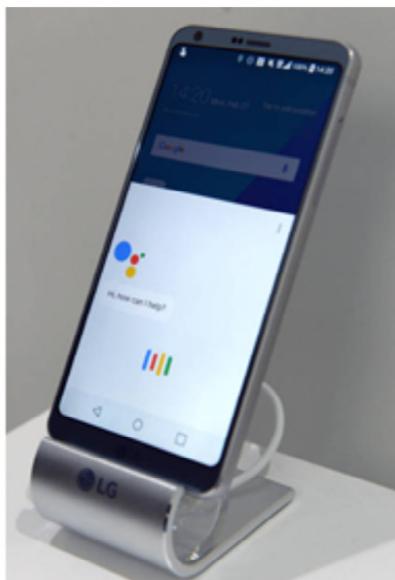
EXHIBIT 647.R-023

## Case study: Assistant - quick ramp to 1B scale with increasing presence

Instant distribution  
Long-press home & AGSA

Premium entry points  
Dedicated H/W button

Increased presence  
Built into OS, suggestion chips, ambient mode



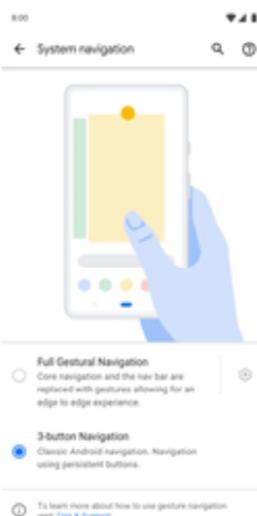
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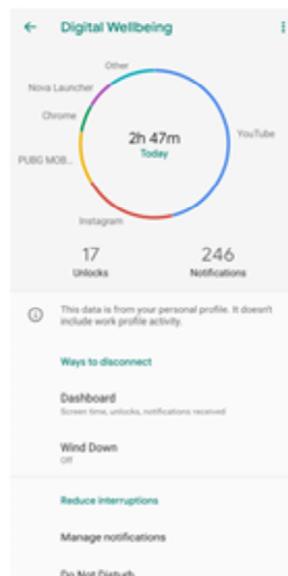
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## We also provide the guardrails for the platform (GMS Requirements)

One gesture please...



Digital well-being for users and control for parents



Safe driving



Fresh device software



Device preload safety



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Ensuring our experiences are not throttled, even in unique circumstances

"Lenovo Smart Tab Powered by Amazon Alexa"  
2-in-1 experience... dagagadg



Hey Google

Google

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# Android Today

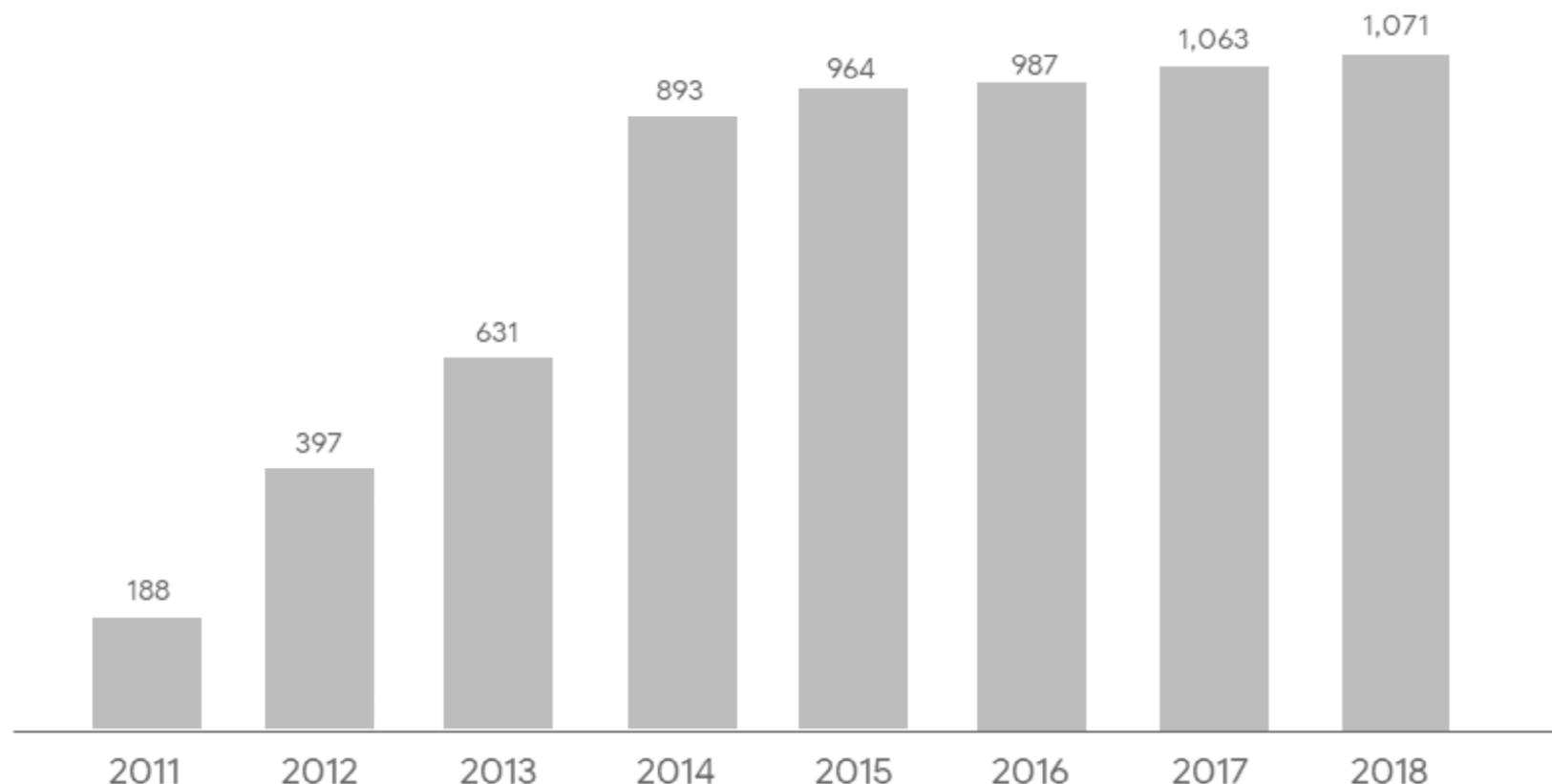
- Current lay of the land
- Key trends
- Where are things headed

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## Mobile remains the largest vertical, but growth is slowing (GMS Activations)

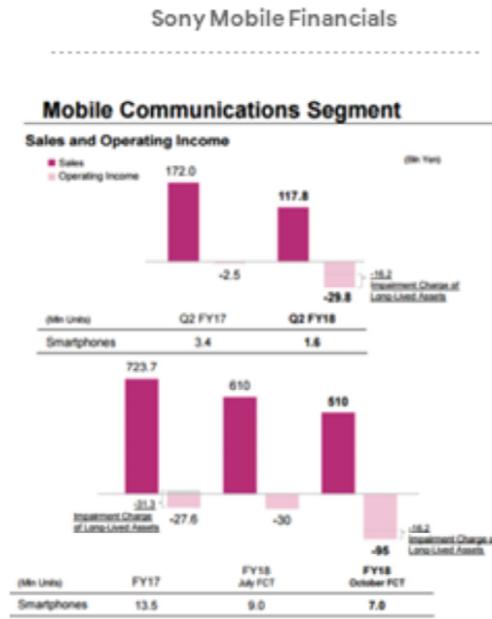
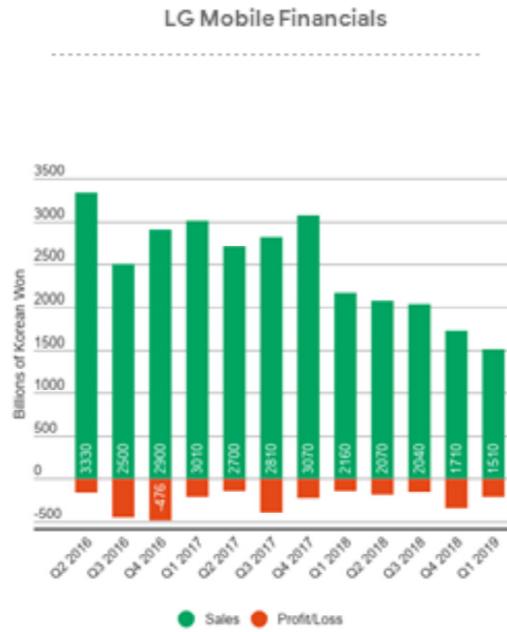


Google

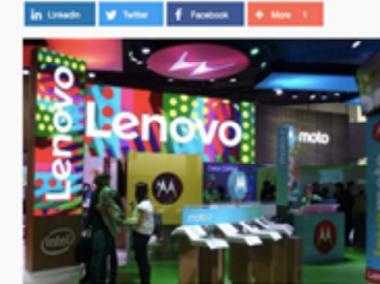
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# Profitability story remains challenging... may get worse over time



## Lenovo makes first mobile profit since Motorola buy



China-based Lenovo's Mobile Business Group posted a pre-tax profit in its fiscal Q3, the first since it acquired Motorola in 2014, despite a double-digit fall in revenue.

In the three months to end-December 2018, the division recorded a pre-tax profit of \$3 million compared with a \$124 million loss in the same period of 2017. Revenue dropped 19.6 per cent year-on-year to \$1.67 billion, which the company said was due to a move to focus on profitable growth in key markets.

Lenovo attributed the turnaround to "masterful execution" on a strategy to reduce expenses, streamline its product portfolio and focus on core markets.

North American volumes outgrew the market by a 40 points and China revenue quadrupled year-on-year, it said.

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AUTHOR



Joseph Waring joins Telecom Review as the Asia editor for its new Asia-Pacific Bureau. Having joined the GSMA, as group editor for Telecom Review for more than ten years, in addition to writing features, news and blogs, he...

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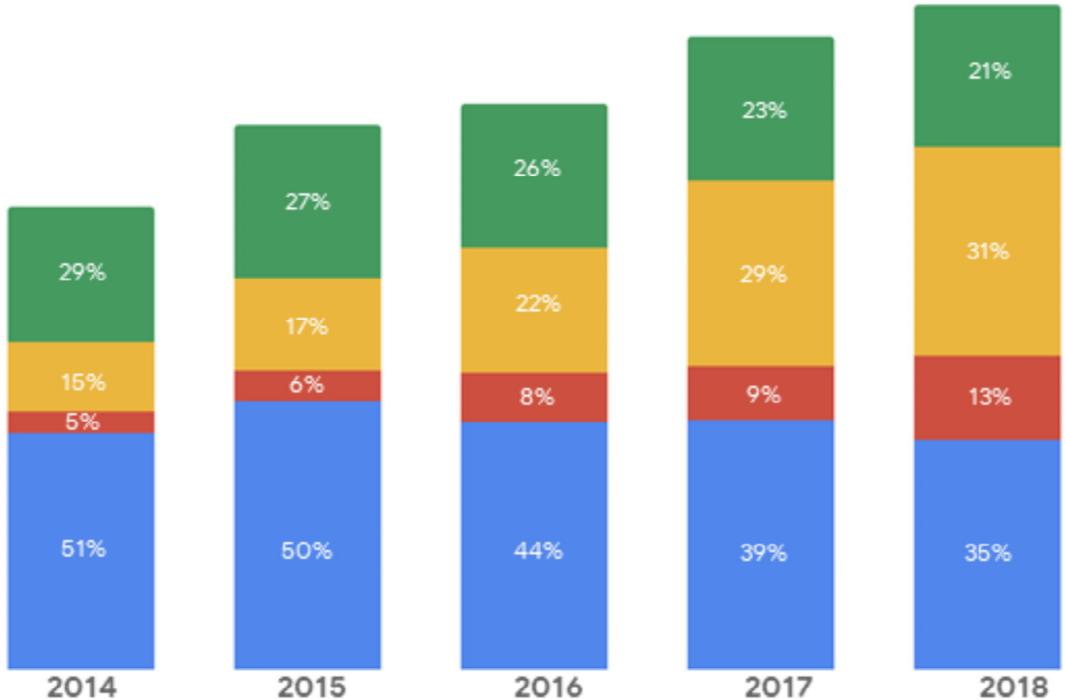
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# CN OEMs share of GMS activations growing; but changes are lurking...

CN OEMs    Huawei    Samsung    Everyone Else

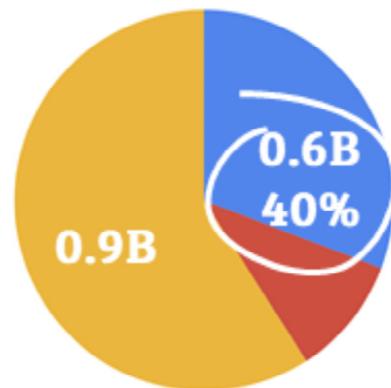
Total GMS Mobile Activations (2014-18)



CN & IN Volume Are Critical to Drive Economies of Scale & Component Access

2018 Global Smartphone Shipments

China    India    RoW



**CN OEM  
SHARE  
GREW 2X  
TO 44%**

Google

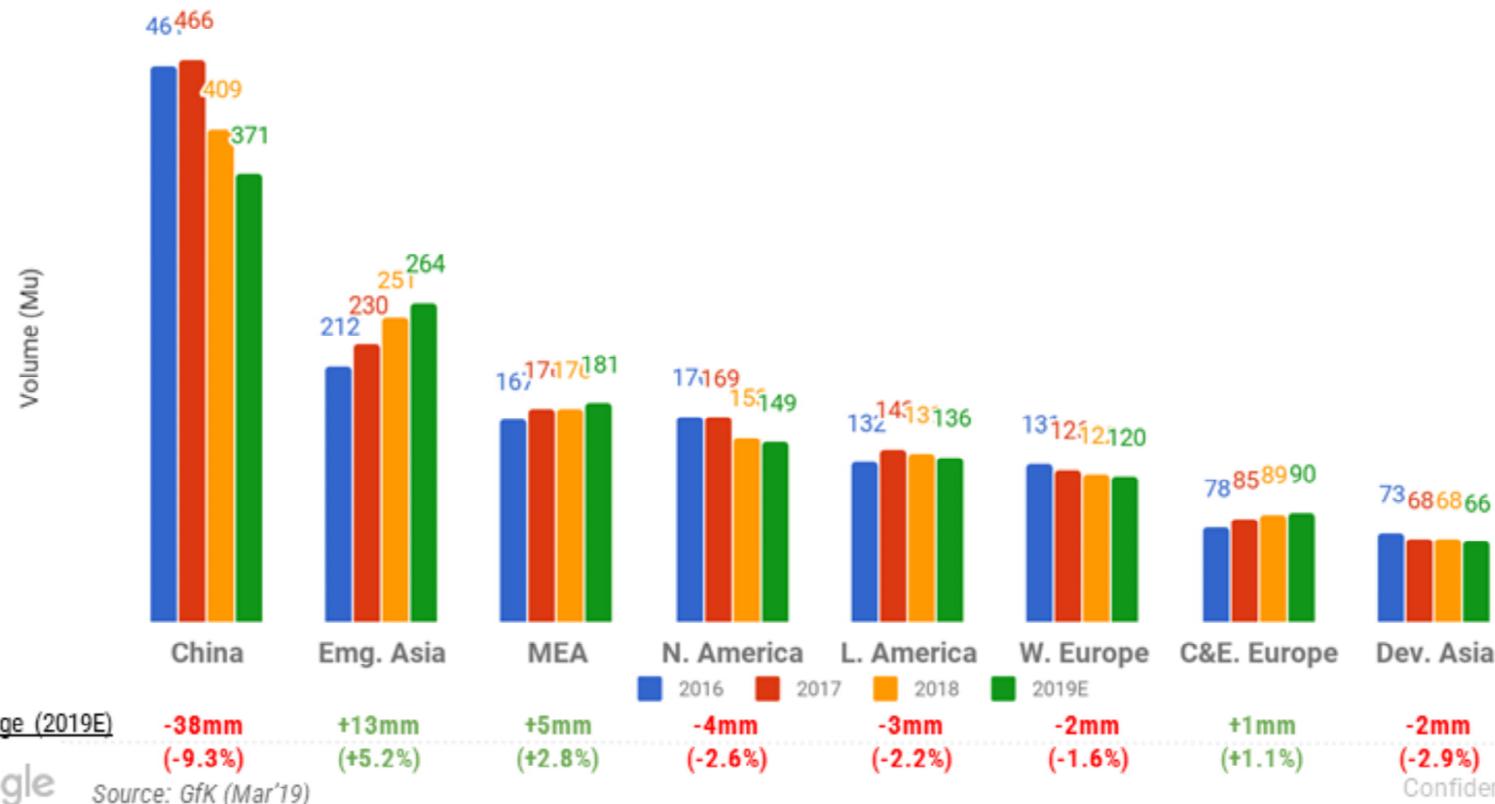
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- Note: "CN OEMs" inc. Xiaomi, Oppo, Vivo, Gionee, TCL, ZTE, Lenovo/Moto, Transsion, OnePlus, Coolpad, Wiko, and Meizu

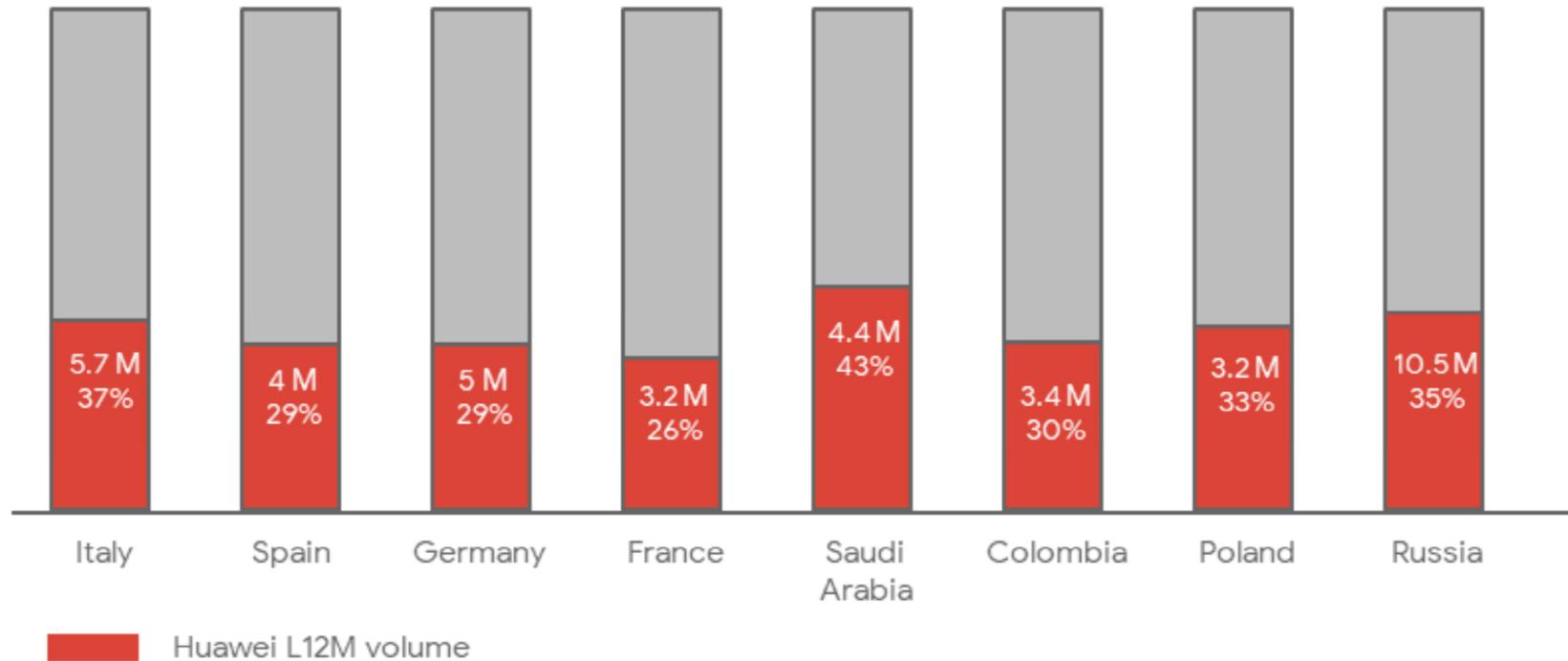
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## CN OEMs Will Continue to Seek Out New Sources of Growth Outside CN

Developing APAC & MEA will serve as new sources of growth. Increased OEM competition in these markets should benefit consumers and have significant secondary effects e.g. helping drive local economies & assembly capabilities, injecting vibrancy into the ecosystem etc. Geopolitical forces will play a major role, potentially resulting in ABC (anywhere but China) supply chain shifts.



... but the latest news changes things

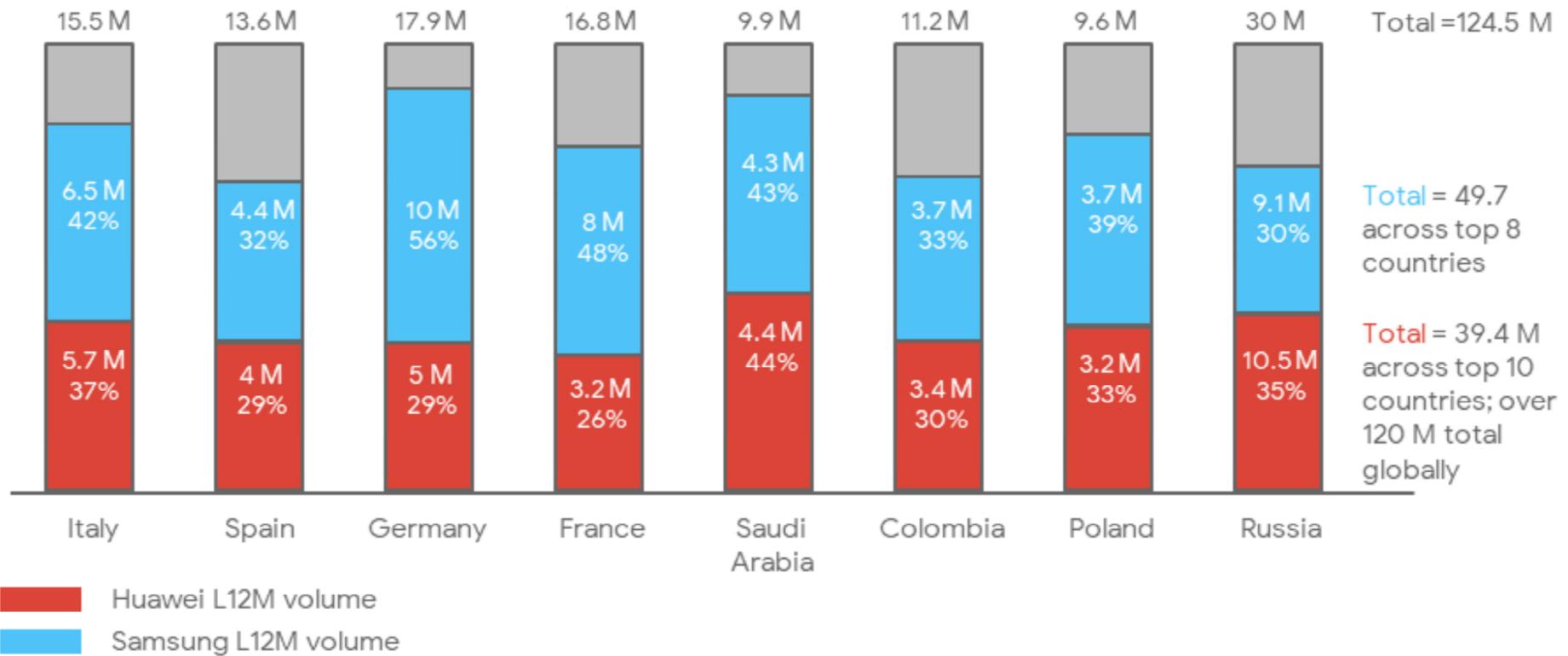


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## Android share in select markets - OEM Portfolio balance a concern



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EXHIBIT 647.R-033

# Challenges on the horizon

- Regulatory (EEA, China)
- Balanced set of partners
- Keeping partners healthy
- Switching
- Alternate 3P platforms
- Execution

## Regulatory



• • •

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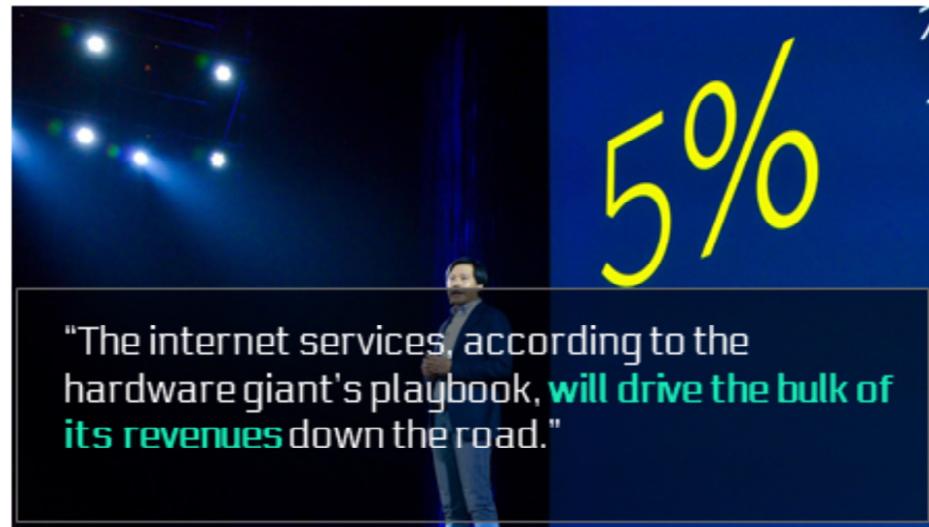
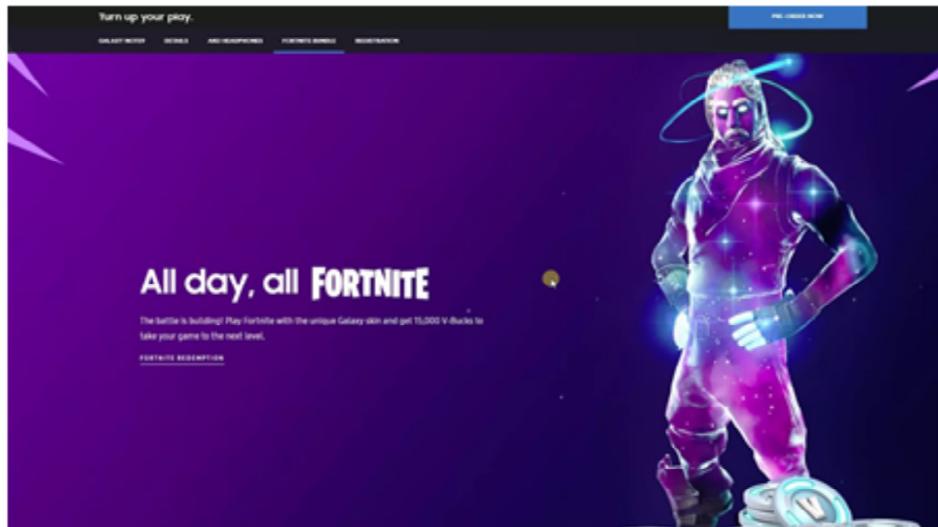
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## Keeping partners healthy, including financially

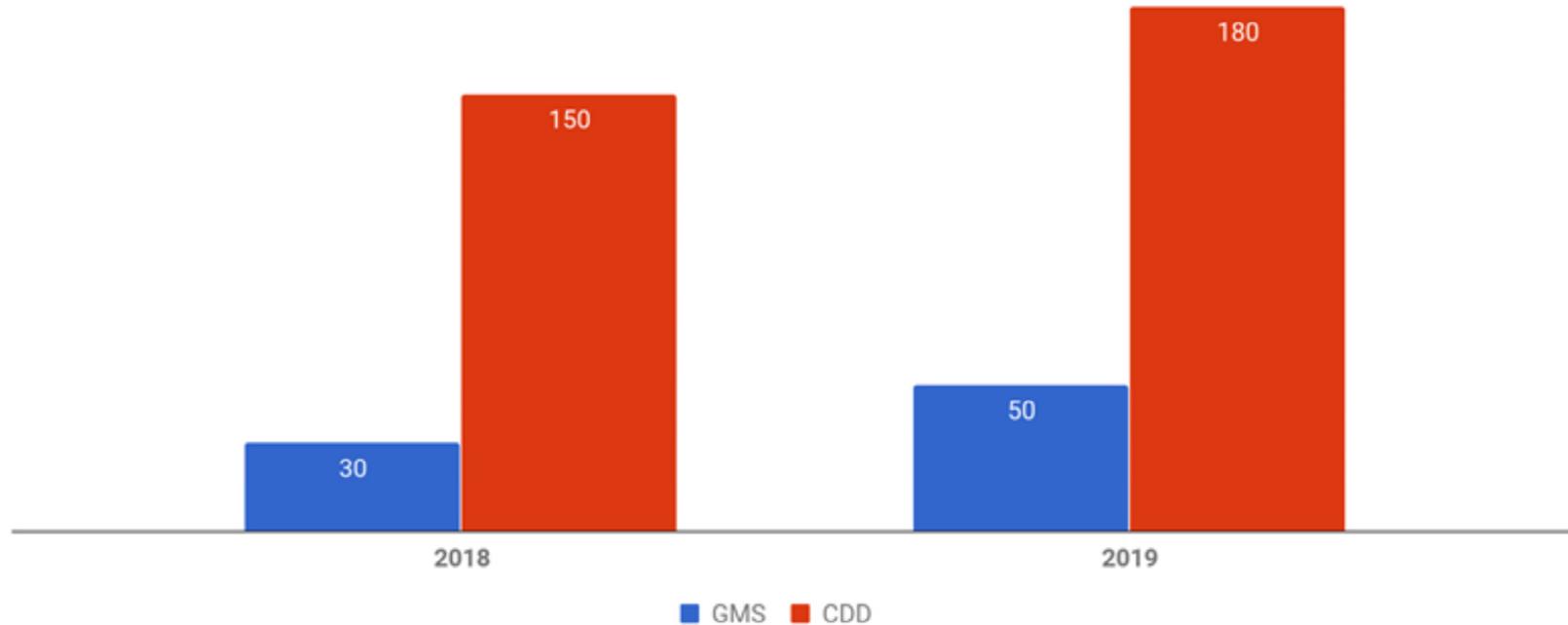


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Asking our partners to do more and more...



*Note: Approximate number of requirements. Also note that increase is not always increasing across multiple years*

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# APPENDIX

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GOOG-PLAY-000128900.R

## Ambitious 3P Platforms



The image consists of three side-by-side screenshots demonstrating Microsoft Launcher's features:

- See what's important to you at a glance:** Shows a feed of news, events, docs, and contacts. A callout text says: "Customize your feed to see the news, events, docs, and contacts you want to see, and remove the stuff you don't."
- There's no place like Home screen:** Shows a custom Android home screen with a blue and teal abstract wallpaper. It displays the time as 12:30 PM, the date as Wed, Oct 4, and the weather as 70° F. App icons include Facebook, Twitter, Google Maps, Instagram, Settings, Microsoft, and Play Store.
- Take a photo on your phone, open it on your PC:** Shows a Microsoft Windows desktop interface. A file named "Screenshot\_2018-10-04-12-30-21-AM.jpg" is being shared via Microsoft Launcher. A callout text says: "Microsoft Launcher links your Android device and PC so you can open photos or docs on a bigger screen, instantly."

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Execution - increasingly complex and difficult to align internally, but an opportunity as well



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## Strong growth in all Android verticals



2X M  
activations / 12M



1 M  
activations / 12M



XX M  
activations / 12M



XX M  
activations / 12M

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EXHIBIT 647.R-041

Slide 41

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2 Jim to fill out  
Christopher Li, 6/19/2019

1 Jim to fill out  
Christopher Li, 6/19/2019

EXHIBIT 647.R-042

## SP & FP Markets Decline in 2018 with CN OEMs Share Rising

We are at single digit shipment growth overall. FP conversion is occurring, albeit slowly. Globally, top-6 OEMs to account for >65% market share and CN OEMs are expected to account for more than half of global SP shipment in '18. (TBD)

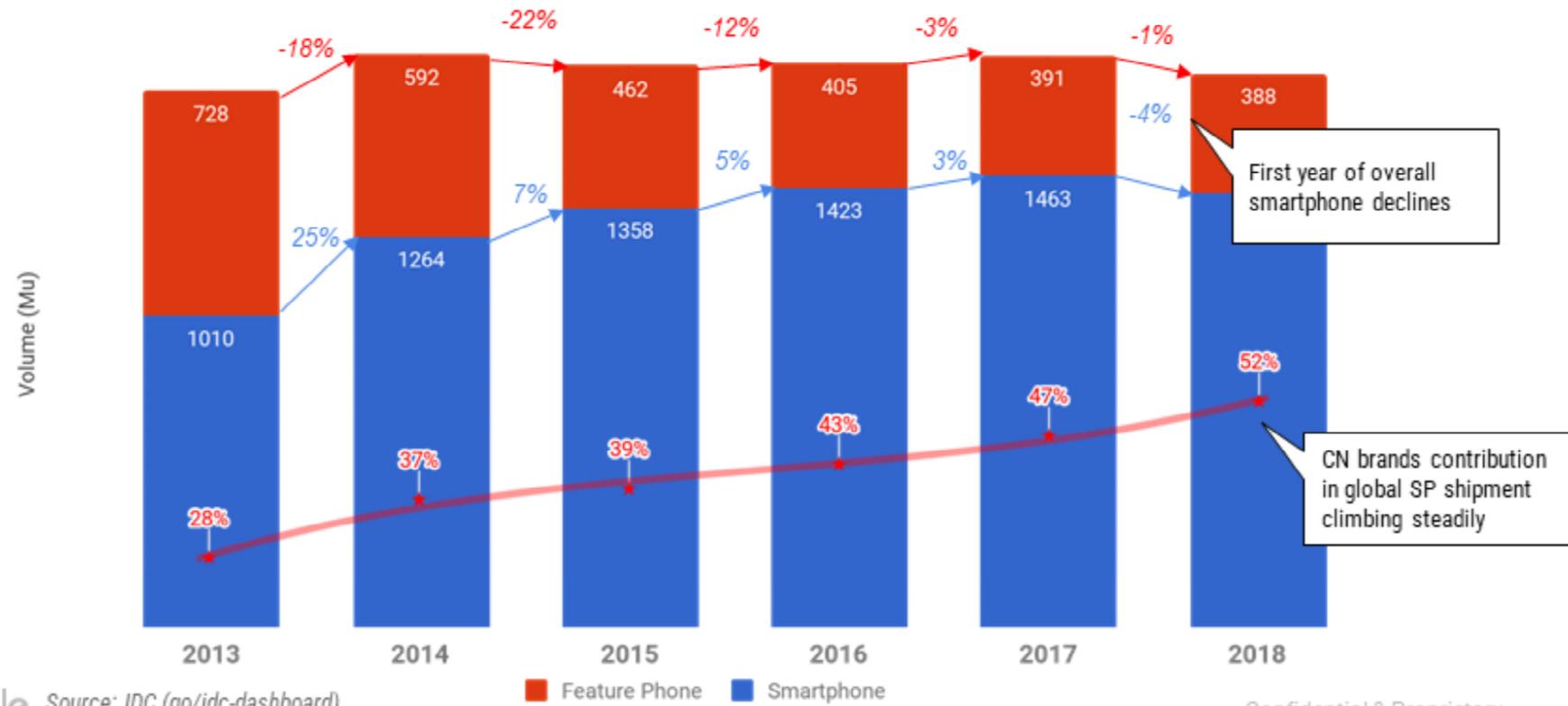


EXHIBIT 647.R-043

# Android Compatibility Requirements



- 1) Comply 100% with the requirements of the Compatibility Definition Document ("[CDD](#)")
- 2) Pass 100% of the Compatibility Test Suite ("[CTS](#)")

CTS is composed of 1000s of automated test cases to ensure compatibility with

platform

**Note:** 1) Google updates CDD and CTS for each version of Android and releases them as part of AOSP. 2) Also, we do have a liberal exception/exemption policy to grandfather in older devices and/or address unique form factors

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## Review of hypothetical scenarios

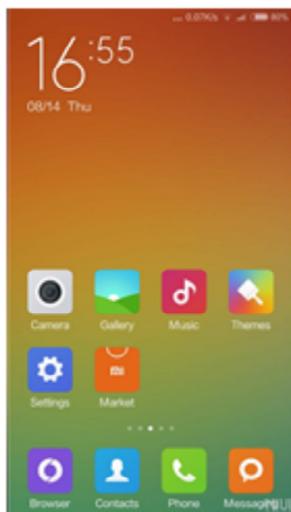
SCENARIO	YES	NO	NOTES
Can a mobile phone without Google Play and GMS core APIs run other Android apps?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes, as long as the apps don't require any APIs from GMS Core or they find ways to replicate API functionality (themselves or other 3P APIs)
Can someone effectively utilize GMS Core APIs without Google Play installed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No, the APIs require and use Play's infrastructure
If a device has Google Play illegally sideloaded, can it access GMS Core APIs?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can access GMS Core APIs, but we cannot validate the authenticity of the Core API functionality. This is why enforcing unlicensed devices is important.
Does Apple offer its own version of iOS "GMS Core APIs"?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	iOS has a similar API model, but there are less APIs and they do not offer as deep functionality

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## Many media-defined Android forks are in fact not forks and are compatible



Xiaomi  
MIUI

**NOT a FORK  
- COMPATIBLE -**



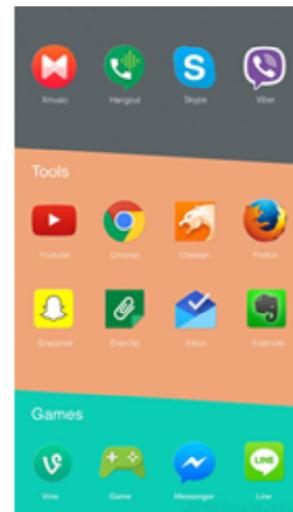
BLU  
Cyanogen 12

**NOT a FORK  
- COMPATIBLE -**



Amazon  
Fire OS

**ANDROID FORK  
-  
INCOMPATIBLE -**



OnePlus  
Oxygen OS

**NOT a FORK  
- COMPATIBLE -**

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